

## **A REVIEW ON VALUE ENGINEERING TECHNIQUES IN INDIAN CONTEXT**

**NEETU B. YADAV<sup>1</sup>, RAKESH KACHA<sup>2</sup>, NEERAJ D. SHARMA<sup>3</sup> & HIREN A. RATHOD<sup>4</sup>**

<sup>1,2</sup>M.E.Student (Construction Management), S.N.P.I.T. & R.C, UmraKh, Bardoli, Gujarat, India

<sup>3</sup>Associate Professor and H.O.D, Department of Civil Engineering, S.N.P.I.T. & R.C, UmraKh, Bardoli, Gujarat, India

<sup>4</sup>Assistant Professor, Department of Civil Engineering, S.N.P.I.T. & R.C, UmraKh, Bardoli, Gujarat, India

### **ABSTRACT**

The paper covers generalized concept of value engineering along with its origin and its year by year historical development in Indian context. This paper also highlights the current application of VE in India and how this concept can be applied for different construction projects of India as per survey from various literatures. India is number one of the top ten spending nations on construction in the world with this regard how this tool can helpful to increase the functional-ability, use-ability, profitability and worth of money invested without compromise with the quality of product or service for the development of nation.

**KEYWORDS:** Indian Construction Industry, Job Plan, Value Analysis, Value Management, Value Engineering

### **INTRODUCTION**

Value engineering, being a very creative and effective approach, must be appreciated and understood at all level of the project management and must be accepted worldwide. The term “value management” is used nowadays in India instead of “value engineering” because it is more a management function than an engineering technique. India's construction sector is assessed at Rs.4000 billion or \$100 billion. India is number one of the top ten spending nations on construction in the world. Production of cement is more than about 250 million tons in India and is second only to China. A recent report "Global Construction 2020", estimates that India will be the third largest global construction market after China and USA. Government of India is spending 9% of the GDP to infrastructure projects.

The National Planning commission has estimated an allocation of \$515 billion which is equivalent to Rs.30 trillion to infrastructure sectors over the next five years. The construction sector employs approximately 31 million people and, after agriculture, is the largest employment sector in the country. With the help of application of Value Engineering in on-going and upcoming construction projects we can improve decision-making that leads to optimal expenditure of owner funds while meeting required function and quality level. VE is a methodology that is comprised of many useful tools and techniques that create change on purpose rather than letting change happen accidentally.

### **DEFINITIONS**

There are numbers of definition given by the different expertise and practitioners of this techniques, and some of them are as mentioned below:

- Miles (1972) “A discipline action system, attuned to one specific need: accomplishing the functions that the customer needs and wants at the lowest cost”.
- Zimmerman (1982) “A proven management technique using a systematized approach to seek out the best functional balance between the cost, reliability and performance of a product or project”.

- Connaught on and Green (1996) “A systematic approach to delivering the required functions at lowest cost without detriment to quality, performance and reliability”.
- Dell’Isola (1997) “An organized process with an impressive history of improving value and quality”.
- Hayles and Simister (2000) “Proactive, creative, team approach to problem-solving in construction projects to provide the best value for money”.
- Standing (2001) “The systematic and creative process for the provision of the necessary functions of a project at the lowest cost by efficient identification and the elimination of unnecessary cost without detriment to: safety, quality, reliability, performance and delivery”.
- Kelly (2004) “The process of identifying and eliminating unnecessary cost during design and construction stages”.
- JSVE (2005) “A professionally applied, function-oriented, systematic team approach used to analyze and improve value in a product, facility design, system or service”.

## ORIGIN

Value is no new concept. It has been with us from the dawn of civilization but, a management methodology based on the value concept, value engineering is rather recent. Origin of Value engineering technology as we know today can be traced back to the World War II efforts to maintain and increase production of all items against scarcity of traditional strategic inputs. The initial development of the value engineering concept was a product of General Electric Company, USA. The man responsible for the development of value engineering concept was Lawrence. D. Miles, an Electrical Engineer within General Electric Company. Mr. Miles was appointed by Mr. Harry Erlicher, Vice President of General Electric Company for the purchasing department. At that time, manufacturing industry in the United States was running at a maximum capacity to supply the allies with arms. There were shortages in steel, copper, bronze, nickel, bearings, electrical resistors & many other materials and component. G.E.C. wished to expand its production of the turbo supercharger for B24 bombers from 50 to 1000 per week. Miles was assigned the task of purchasing the materials to permit this. Often he was unable to obtain the specific material or component specified by the designer, so Miles reasoned, "if I cannot obtain the product, I must obtain an alternative which performs the same function". Where alternatives were found they were tested and approved by the designer. Miles observed that many of the substitutes were providing equal or better performance at lower cost and from this evolved the first definition of value engineering.

## CONCEPT OF VALUE ENGINEERING

Value concept can be stated as: that an item is intended for a purpose, the user buys it for this purpose, and it is of value for him if it accomplishes the purpose efficiently, effectively, and well, at the optimum cost. Value engineering concentrates on the effectiveness through stating functions, goals, objectives, needs, requirement and desires. Value engineering is a technique which aimed at an organized, systematic efforts directed at analysing functions of items, products, equipment's, process, procedures for the purpose of accomplishing all the required functions at the lowest total cost. How well these two objectives –maximising satisfaction regarding quality and standard and minimising the cost– have been fulfilled so that value has been secured. In other words, an indication of value realized can be had the simple equation:

$$\text{Value (V)} = \frac{\text{Function (F)}}{\text{Cost (C)}}$$

Where V represents value, F represents the sum total of function performance, i.e. the satisfaction achieved and C represents the cost paid for it. In other words, we can say value is absolutely opposite to cost. This is the core of value thinking whether in a simple product or a major investment project. The relation of F and C says that the lower the cost for optimum function, the better the value. So the value engineering can be defined "A systematic method to improve the "value" of goods or products and services by using an examination of function". Value Engineering is a balance between Function, Quality and Cost. The Value Engineering approach aims at promoting value awareness and raising the level of professional competence and technological excellence in the company. This concept has following parameters like function, Quality, life cycle cost, Overall expenses, Waste.

## DEVELOPMENT IN INDIAN CONTEXT

**Table 1**

Year	Development
1977	The Indian Value Engineering Society (INVEST) was founded in October. First national Conference held in New Delhi.
1981	2nd INVEST National Conference, New Delhi.
1982	3rd INVEST National Conference, Bangalore. And Invest Eastern Zonal Chapter inaugurated, at Jamshedpur.
1983	4th INVEST National Conference, New Delhi.
1984	5th INVEST National Conference, New Delhi.
1985	6th INVEST National Conference, Jamshedpur.
1986	The Society of Indian Value Management (SIVAM) founded in Bangalore.
1989	SIVAM convenes First Value Engineering conference, Bangalore.
1990	7th INVEST National Conference, New Delhi.
1991	8th INVEST National Conference, Bombay.
2012	2 <sup>nd</sup> Asian Conference on Value Engineering - a key initiative by Asian countries for Sustainable Growth, New Delhi.

## APPLICATION OF VALUE ENGINEERING IN DIFFERENT CONSTRUCTION PROJECTS OF INDIA

**Table 2**

Project	Findings and Savings
Seven storey building of the Institute of Pathology, New Delhi by CPWD	<ul style="list-style-type: none"> <li>✓ Saving of 9.2 lakhs i.e. about 8% of the total project cost.</li> <li>✓ Some changes have been increase the circulation space so it was utilized for the laboratory and other uses-increasing functional-ability without use of other resources.</li> <li>✓ And many more recommendations in design and etc.</li> </ul>
Police housing Scheme at Delhi	<ul style="list-style-type: none"> <li>✓ Optimum use of interior space was analyzed by the team by making adjustments of layout of rooms and in turn the livable area was increased by about 4 %.</li> <li>✓ Improvement in specification has made which cost additional 12.80 lakhs, which was about 2.4% of the project cost but this cost provides long term benefits by way of saving in life cycle cost.</li> </ul>
Higher secondary school building at Najafgarh Delhi	<ul style="list-style-type: none"> <li>✓ Total cost saving of project was Rs.11.87 lacks which was 6.6 % of the total project cost.</li> <li>✓ Improvements in the some of the finishing items were improved.</li> </ul>
Hiranandani Gardens project- a residential complex at Powai, Bombay.	<ul style="list-style-type: none"> <li>✓ In this project the cost saving is of 8-10% of total project cost.</li> <li>✓ With this VE project it became possible to deliver the project on time with the highest quality.</li> </ul>
Large building complex on the north of the Mehrauli-Badarpur road in Delhi.	<ul style="list-style-type: none"> <li>✓ Architecture planning has been modified as eight-storied blocks with two basements.</li> <li>✓ This decision helps in reduced cost, Optimum utilization of site adhering to the maximum permissible FAR, ground coverage regulations and parking space.</li> </ul>
Navodaya Vidyalaya Building, New Delhi	<ul style="list-style-type: none"> <li>✓ As result of VE, saving of 200 sqm area of workshop and 66 Sq m of circulation area.</li> <li>✓ Cost of construction is of 2500 per sq m for semi-permanent structure and 3000 per sq. m for permanent structure.</li> <li>✓ Saving is of 5 lakhs and 1.98 lakhs in semi-permanent and permanent structures.</li> <li>✓ Net saving is of 6.98 lakhs of space utilization.</li> </ul>

In all this projects, application of value analysis is applied on the different stages of the construction project like: Design stage, Architectural design stage, Structural design stage, Execution stage and so on.

## **VALUE ENGINEERING JOB PLAN**

Application of Value Engineering/Analysis is done by using Job Plan which is an organized and systematic approach. VA job plan is the key of success for a value management exercise. It is through this plan that the already identified areas of value study are subjected to in-depth application to seek new and creative alternatives. The Job plan required the formation of a multidisciplinary team representing a cross section of technical field to conduct the program. A multi-disciplinary approach generates more and better ideas, gives greater impact of decisions and costs on all services, and develops better communication among the members of team. There are different job plan existing and are selected as per suitability of the project and requirements, which are entitled as:

- Five phase Job Plan (Standard)
- Six phase Job Plan (US/EPA)
- Seven phase Job Plan
- Eight phase Job Plan (GSA-General Service Administration)

Job plans mentioned above comprises of the selected set of phases as mentioned below, which are identified from various literatures: Information Phase, Investigation phase, Creative Phase, Analytical Phase, Judgment Phase, Development Phase, Recommendation phase, Presentation Phase, Implementation Phase and Follow-up Phase. Out of which most commonly used phases for above completed projects in India, which is considered as five phase Job plan also known as standard job plan and most suitable in Indian context are described as below:

### **Information Phase**

In this phase maximum information regarding problem is collected from various aspects of the project to clearly identify the problem to be solved and gather information on the background, function and requirements of the project. The importance of this phase lies in collection of as much possible to collection of information for understanding and assisting the problem, as it is said that “The problem well known, is the problem half solved”.

### **Creative Phase**

The VA team lists creative ideas generated from its review of the project with the aim of obtaining a large number of ideas through brainstorming and association of creative proposals. The VE team is looking for the greatest quantity of ideas, which will subsequently be screened, in the next phase of the study. This issue is one of the most challenging for VE team members and participants. Many of the ideas brought forth in the creative phase are a result of work done in the function analysis and pre-study efforts.

### **Judgment Phase**

Creative ideas are analyzed, and the team selects the best ideas for further development. The VE team evaluates the ideas developed during the creative phase. The VE team ranks the ideas. Ideas found to be irrelevant or not worthy of additional study are disregarded; those ideas that represent the greatest potential for cost savings and improvements are selected for development are selected for the further development.

### **Development Phase**

The team prepares alternative designs with capital and/or life cycle cost comparisons of original designs and proposed alternatives. All recommendations are supplemented with written descriptions, sketches, basic design concepts, technical information and cost summaries. The selected ideas are developed into proposals that are clearly written so that the owner and other project stakeholders understand the intent of the proposal and how it benefits the project, and also to identify any potential negative factors associated with the proposal.

### **Recommendation Phase**

The recommendation phase is important, as the selected alternatives are presented to top management with the full comparative position of costs as well as technical ranking. The major changes in design are also described briefly with sketches, drawings or models as appropriate.

## **CONCLUSIONS**

The investment on the construction sector and infrastructure development of India, states the importance and vital role of construction industry. Again, apart from the huge amount associated, construction sector has verities of construction projects involving large number of stakeholders, materials, construction and management techniques, et al. which states a wider scope of application of the value engineering/management. Considering the characteristics of the Indian construction industry, it would be possible through VE studies to identify and overcome the various loop holes with creative alternatives which will result into higher productivity, cost reduction, better performance, better quality, simpler design (Civil, structural, mechanical, etc.) and optimum project duration without affecting the function of any project or service. The above presented summary of VE on some of the projects in India clearly states the impact in the terms of capital saved or improved function-ability and use-ability of the project at the same cost, and hence an approximation can be made about how much amount can be save from the construction industry in coming future which would be unnecessarily been wasted to achieve the stated functions of the project. As we all know India is a developing country and the financial aspect plays a very important and crucial part and hence even a small percentage of capital saved from the construction sector, which involves a huge amount, can be diverted and used in various other sectors for the overall development of the nation.

## **ACKNOWLEDGEMENTS**

The authors are thankfully acknowledge to Mr. J. N. Patel, Chairman Vidyabharti Trust, Mr. K. N. Patel, Hon. Secretary, Vidyabharti Trust, Dr. H. R. Patel, Director, Dr. J. A. Shah, Principal, S.N.P.I.T. & R.C., Umrakh, Bardoli, Gujarat, India for their motivational & infrastructural supports to carry out this research, Dr. Neeraj D. Sharma, HOD Civil Department, SNPIT & RC, Umrakh, lastly Mr. Krishnaraj A. Khatri to support in all regards.

## **REFERENCES**

1. Larry W. Zimmerman & Glen D. Hart, Value engineering: A Practical approach for Owner, designers and Contractors, CBS Publisers& Distributors.
2. S. S. Iyer, Value engineering 3<sup>rd</sup> edition new age international Publishers.
3. S. S. Venkataramanan, Role of Value Engineering in Project Management, How and Why? Oxford & IBH Publishing Co. Pvt.Ltd.
4. T. K. Gupta, Value engineering in Project Management, Oxford & IBH Publishing Co.Pvt.Ltd

5. K. A. Patel, Value Engineering in Project Management, Oxford & IBH Publishing Co. Pvt. Ltd
6. K. B. Rajoria and S. S. Jasrotia, Value Engineering in civil Engineering Projects methodology and Case Studies, Oxford & IBH Publishing Co. Pvt. Ltd.
7. Inder R. Jaggi, Value engineering in building construction projects, Oxford & IBH Publishing Co. Pvt. Ltd.
8. K. B. Rajoria and Jag Mohan Lal, Value engineering of a Navodaya Vidyalaya Building, Oxford & IBH Publishing Co. Pvt. Ltd.
9. [www.productivity.in/knowledgebase/Value%20Analysis.pdf](http://www.productivity.in/knowledgebase/Value%20Analysis.pdf)
10. The U. S. Army industrial engineering activity, march 1997, Value engineering program management guide
11. Nick Rich, BSc MBA Matthias Holweg, Dipl.-Wirtschaftsing.(FH) MSc, January 2000,
12. Lean Enterprise Research Centre Cardiff, United Kingdom, Value analysis Value engineering.
13. Abdulaziz S. Al-Yousefi, CVS-Life, FSAVEI, President, Al-Yousefi Value Engineering (YVE), Value Engineering application benefits in Sustainable Construction.

## AUTHOR'S DETAILS



**Neetu B. Yadav** was born in 1985 in Aligarh District, UP. She received her Bachelor of Engineering degree in Civil Engineering from the Pune University, Maharashtra in 2010, At present he is Final year student of Master`s Degree in Construction Management from S. N. Patel Institute of Technology & Research Center, UmraKh, Bardoli, under Gujarat Technological University.



**Rakesh Sureshbhai Kacha** was born in 1989 in Surat District, Gujarat. He received his Bachelor of Engineering degree in Civil Engineering from the Charotar Institute of Technology Collage, Changa, Gujarat Technological University in 2012, At present he is Final year student of Master`s Degree in Construction Management from S. N. Patel Institute of Technology & Research Center, UmraKh, Bardoli, under Gujarat Technological University.



**Dr. Neerajkumar Dineshchandra Sharma** borned in 1978 in Bharuch district the southern part of Gujarat State. He has completed his Diploma from Government Polytechnic Bharuch and was state topper in the batch of 1996. He has completed his bachelors from REC-SURAT with higher distinction and Post Graduate in Environmental Engineering from NIT SURAT with achievement of GOLD MEDAL. He has completed his Ph.D in Civil Engineering from NIT SURAT under the guidance of Dr. J. N. Patel, Professor –Civil Engg. Dept (SVNIT) in the interdisciplinary streams of civil engineering domain i.e Water resources Engineering and Environmental engineering with title of “Improving Groundwater Quality through Artificial Recharging”. He has published/presented more than 5 international journal papers and 17 Conferences. Presently he is Associate Professor as well as Head of Department of Civil Engineering at S.N.Patel Institute of Technology & Research Centre –Umrakh near SURAT. He has dedicated more than one decade towards his academic career alongwith 4 years industrial experience. He is life time member of ISTE, ISH, IWRE and IE. Apart from this he has participated/organized STTPs, Workshop and delivered expert lectures to impart the technical knowledge. Apart from this he has done his Post graduate Diploma in Environment and Sustainable Development from IGNOU and Advanced Diploma in software engineering. His work of interest is remained in Information technology and computer science equally as in Civil Engineering.



**Hiren Amratlal Rathod** was born in 1990 in Kandla Town, Gandhidham Taluka, Kutch District, Gujarat. He received his Bachelor of Engineering degree in Civil Engineering from the Birla Vishwakarma Mahavidyalaya Engineering Collage, Sardar Patel University, Vallabh Vidya Nagar in 2011 with higher distinction, Master`s Degree in Construction Engineering and Management from Birla Vishwakarma Mahavidyalaya, Gujarat Technological University in 2013 with higher distinction and achievement of GOLD MEDAL. He is working as an Assistant Professor in the Civil Engineering department of S. N. Patel Institute of Technology & Research Center, Umrakh, Bardoli, under Gujarat Technological University since 6 months and has overall experience of about one year and six months in the academics. He has published more than 4 papers in the various international journals. Apart from this he has participated/organized STTPs, Workshop and delivered expert lectures to impart the technical knowledge.

